Abt Associates Inc.

memorandum

Environment and Resources

55 Wheeler Street, Cambridge, MA ◆ Tel: 617 492-7100 ◆ www.abtassociates.com

Date	May 28, 2010
To	Todd Doley, U.S. Environmental Protection Agency
From	Marisa Mazzotta, Elena Besedin, Dan Basoli, and Michael Fisher, Abt Associates
Subject	Property Value Effects of LID Practices – discussion draft (Task 7e and 11)

1 Introduction

Low impact development (LID) includes a variety of methods for retaining stormwater onsite, either permanently or temporarily, in order to slow stormwater flow and filter stormwater. LID best management practices (BMPs) are likely to affect property prices. While some BMPs may lower property values, many may add aesthetic and other amenities that increase property values. These amenities can include increases in open space in a neighborhood or subdivision, more trees and other vegetation on or near a parcel, green spaces or gardens, water features, and improved wildlife habitat. These amenities and benefits may accrue both to residents of the neighborhood or subdivision, and to people who live nearby.

LID developments may be designed in various ways. They may involve alterations to conventional grid or cul-de-sac style neighborhoods, such as replacing impervious surfaces with porous materials, and adding rain gardens and other vegetated features; or they may involve alternative neighborhood design, such as cluster development or conservation development.

The purpose of this memorandum is to review and describe the available literature that relates property values to potential results of LID BMPs, and to discuss approaches that might be applied to estimate price effects from LID practices.[1] Two limitations are important to mention. [redacted] we are basing our suggested approaches on information from the literature. Second, we have found very few studies that specifically address price effects of LID practices. Therefore, we are making assumptions about how LID practices might change various amenities, and evaluating the literature in terms of valuing these amenities.

Changes in property values represent only a subset of the total possible value/benefit effects from LID. Other potential benefit categories include reduction in adverse human health effects, improvements in ecological services provided by the affected land and water resources and cost savings from reduced capital and maintenance cost of infrastructure, and drinking water storage and treatment. These benefit categories are discussed in separate deliverables under this work assignment.

[1] Per technical direction from the assignment manager (received 5/18/10), the literature review and methodology development activities under Task 7e and 11 have been combined into this single memorandum due to the broad overlap of literature and concept in these tasks of the WA Amendment.

2 General Approaches to Valuing the Benefits of LID

We found a large body of economic literature that provides insights into changes in property values due to changes in on-site and off-site amenities such as tree cover, proximity to open space, presence of parks /forested land in the neighborhood and others. With only a few exceptions, the available studies of property values do not provide a direct link between property values and LID or BMPs *per se*. To evaluate the benefits of LID practices, we will first need to link actions (i.e., LID practices and/or specific BMPs) to results that produce the various amenities that may affect property value, and then evaluate the benefits to affected property owners from those amenities. To accomplish this, we must first define LID practices of interest, and then determine how those practices affect amenities. For example, how do LID practices change tree cover and open space in a neighborhood and larger geographic area? We must also determine the geographic extent of effects.

Based on our review of existing literature, results of (or, amenities produced by) LID practices that could affect property prices include:

- Changes in open space within a certain radius of a parcel
- Changes in vegetative cover on a parcel or in a neighborhood
- Changes in water features, including ponds and wetlands
- Changes in recreational opportunities
- Aesthetics – views and pleasing surroundings
- Wildlife (habitat)
- Air and water quality
- Water quantity
- Climate regulation (shade, windbreaks, etc.) that reduces heating and cooling costs
- Flood mitigation

Changes in some of the above amenities can be monetized using benefit transfer from the available studies; others will be discussed qualitatively.

The overall model must be framed in terms of changes from a baseline, where the baseline is defined as "business as usual" development, and LID development outcomes (in terms of open space, tree cover, etc.) are compared to baseline outcomes. Changes in key property characteristics relative to the baseline can potentially affect two types of property owners: those who live in the neighborhood or subdivision incorporating the LID practices, and those who live nearby.

The relevant LID impacts will need to be quantified relative to the baseline, possibly in terms of percent change in various amenities on a parcel, within a neighborhood or subdivision, and within a larger area (to be determined). The benefits from these changes can then be evaluated.

Effects on nearby property owners will vary depending on scarcity of open space and rates of development; the effects of LID practices on nearby properties will thus likely vary depending on existing development density (Fausold and Lilieholm 1996). In urban areas, where LID practices are added in areas that are already heavily developed, these practices may increase overall open space and green space, providing amenities to people well beyond the actual LID neighborhood. For example, Seattle's Street Edge Alternative (SEA) street is a one block area that was redesigned to incorporate LID practices. Besides value to residents, it "is reported to attract walkers and bicyclists from the neighborhood as well as international visitors interested in low-impact development and natural drainage systems."(Wong and Stewart, 2008, p. 1)

At the other extreme, in rural, low density areas, benefits may be minimal beyond the actual LID development, since the marginal effects on overall open space will be small. However, in the intermediate

case of suburban areas, there is likely to be a geographic area surrounding the LID development where benefits, compared to the baseline case, are important to those not residing in the development. Thus, the model of benefits to property owners outside of the LID subdivision or neighborhood will need to address baseline development density.

We are considering three general approaches to estimating benefits using benefit transfer:

1. *Case Studies.* The first approach would take a set of analyses or case studies and, from them, illustrate a range of price effects and factors that are most important. These would then be applied to a set of examples representing the potential range of benefits from the proposed regulation. A number of studies of the value of parks and open space use this approach (see, e.g., TPL studies, etc.), applying a range of percentage changes in property values.
2. *Meta-Analysis*. The second approach is to develop a meta-analysis of existing studies that incorporates various amenities plus distance to the parcel to estimate the value of a given percent change within a radius of the LID practices. Given the number of hedonic studies available, a meta-analysis may be an effective way to estimate a range of benefits for different amenities under differing conditions (e.g., urban, suburban or rural housing densities), and can include both effects within a neighborhood and beyond the immediate neighborhood.
3. *Original Hedonic Studies.* Finally, it might be worthwhile to pursue original hedonic studies, either to augment the meta-analysis for aspects that are not widely covered in the literature, or to produce a better case study approach for benefits that may not be addressed in the meta-analysis. One paper, by Shultz and King (2001), reports on a hedonic study conducted using census block data rather than actual home sales data. This could be a viable approach to estimating benefits for larger regions, for aspects of LID that are not covered by existing hedonic studies, like percent impervious surface.

[redacted]

3 Literature Review Summary

We reviewed over 140 papers, around 40 of which were not relevant for our purposes, and found around 100 relevant in various ways, including 63 hedonic studies that estimate property value changes from improved amenities that could result from LID practices.[2] In addition, we compiled a list of over 40 more studies that could be relevant, but have not yet completed an exhaustive review of this literature.

3.1 Studies Directly Related to LID

Very few studies directly address values related specifically to LID (or related) practices, and most of these use proxy measures, such as open space, for LID effects. Key studies are summarized below:

- Mohamed (2006) evaluated price premiums, costs, and selling time for lots in conservation subdivisions in South Kingstown, Rhode Island, and found that prices were 12 to 16 percent higher for lots in conservation subdivisions, compared to lots in other subdivision types. These lots were also less expensive to build, and sold more quickly than lots in conventional subdivisions.

[2] The additional studies are either reviews of other studies; benefit transfers; general information on LID practices, costs, and benefits; studies based on avoided costs; or case studies of actual LID developments, most of which focus on costs to developers.

- Netusil (2005) examined how environmental zoning and amenities are related to the price of single-family residential properties in Portland, Oregon, including both amenities located on privately owned properties, and in the neighborhood surrounding these properties. The study estimated both a "development effect" (negative effect related to restrictions) and an amenity effect. The study found that the net effect of environmental zoning varied by location and amenity type. "For example, properties in Southwest Portland with a c-zone designation are estimated to sell for 2.60% less than properties without any environmental zoning. The presence of tree canopy, an amenity protected by environmental zoning that is common in Southwest Portland, within 200 feet and between 200 feet and 1/4 mile of a property is estimated to increase a property's sale price by 3.14%. The estimated net effect is positive, but small (0.54% or $1,382 evaluated at the mean sale price of properties in Southwest Portland). Other examples would arrive at different estimates (Netusil 2005, 245)."
- Lee and Li (2009) looked at property values in relation to two different detention basin designs, in two College Station, TX, subdivisions. One subdivision had single use flood control detention basins, and the other integrated a detention pond with a recreational neighborhood park. They found that property values in the subdivision with the single use basins were lower than those that included a park. They also found that properties closer to the detention pond with park were more valuable.
- Kopits, McConnell, and Walls (2007) evaluated clustered subdivisions with open space compared to conventional subdivisions. They found that both lot size and subdivision open space increase property values. They also found that subdivision open space may substitute for private lot size, and that lots adjacent to subdivision open space were valued higher than those not adjacent. On average, house prices were found to be slightly lower with the clustering, particularly for lots not adjacent to open space.
- Thompson (2008) evaluated conservation developments in rural western North Carolina, and found that lot prices were 40% higher in conservation developments, compared to conventional developments. The author also found that the conservation developments were less expensive to build.
- Shultz and Schmitz (2008) evaluated effects of LID subdivisions on property values in Douglas County (Omaha), Nebraska. However, because there were no LID subdivisions in the area, they used various types of open space as proxy measures for LID designs. They estimated a set of 14 hedonic valuation models, across 326 subdivisions, to quantify how different types of open space characteristics affect residential property values. They found that the following characteristics affected values:
  - Privately owned open space was more valuable than publicly owned
  - Open space with trees and mowed grasses was more valuable than non-mowed areas or areas with sports facilities
  - Open space with trails was more valuable than without trails
  - Values were 1.1% higher for clustered open space designs, and 2.74% higher for open (contiguous) open space designs than for conventional sub-division designs

  The authors also mention that they evaluated values relative to distance from the open space, but do not report results in this paper (they refer the reader to Schmitz's Master's Thesis for more detail).

- Bowman, Thompson, and Colletti (2009) examined values for conservation subdivisions in Cedar Rapids, Iowa. Because no true conservation subdivisions existed, they use subdivisions with significant embedded open space areas, including protected meadows, forests, and wetlands as proxies for conservation subdivisions, and compared these to standard subdivision designs. The study includes transactional analysis, hedonic analysis, and contingent valuation. The hedonic models indicated significant positive marginal effects due to the presence of open space/conservation features. On average, open space added 4% to home values in the conservation subdivisions. Respondents to the contingent valuation survey, from both types of subdivisions, reported willingness to pay for additional open space/conservation features in their neighborhoods, with an average willingness to pay of $4300 for additional open space.
- Williams (2003) evaluated four alternative site planning and storm-water management designs in a hypothetical residential development in the Gainesville, Florida area: traditional development with full-size lots and conventional storm-water management; cluster development with reduced lots for upland preservation and conventional storm-water management; "partial" low impact development with an LID storm-water management system on the full-size lot plan; and "full" LID with an LID storm-water management system on the cluster development plan. As in most of the other studies reviewed here, open space proximity and type were used to value the LID developments. The author found that reducing lot size would adversely impact the profit from development, but that maximizing open space frontage would partially mitigate this loss. Also, construction costs for the LID designs were lower than the designs using conventional storm-water management. Overall, the ratio of profit to cost was highest for the full LID plan.
- Williams and Wise (2009) evaluated estimated construction costs and sales revenues for four development alternatives for a hypothetical residential subdivision in Gainesville, Florida. The authors found that reduced lot size and a swale-based stormwater drainage system, as compared to a curb and gutter system, both reduced sale price per lot, even with increased open space. However, this combination of practices resulted in the lowest per-lot construction cost. The ratio of revenue to costs varied by time period, with the open space/swales option preferred in the earlier period but not in the later period.
- Wise, et al. (2010) review the benefits of LID practices, and in their section on property values, reference literature that values the impact of new tree plantings (increases property values from 2 to 10 percent); and proximity to parks, gardens, and ponds (increases property values from 9 to 25 percent). They caution that, for benefits beyond the borders of the LID site, "the challenge of determining property value benefits lies partially in measuring the geographic range of the associated benefit. (p. 1135)."

3.2 Studies Related to Amenities that Would Be Created by LID Practices

So far, we have located and reviewed 63 potentially relevant hedonic studies, and 8 potentially relevant stated preference studies, summarized in Table 1. Four of the stated preference studies also include hedonic studies.

Of amenities valued in the hedonic studies, 29 value open space, 25 value trees or other vegetation, 21 value parks or community gardens, 6 value greenways, 7 value riparian buffers, 5 value wildlife habitat, 19 value various types of water bodies, 9 value views, and 4 value wetlands. Many of the studies include additional types of open space, including forests, golf courses, and farmland, but we do not list those here as they are not directly relevant to LID. Also, there are many more studies that value wetlands, including some that incorporate vegetation types, but we have not yet reviewed wetlands valuation studies.

Twenty of the hedonic studies value amenities on individual parcels, including four that address aspects of landscaping. Five studies address cluster housing, and 6 address conservation subdivisions. Thirty-seven of the hedonic studies evaluate amenities within a neighborhood or development, and 41 evaluate amenities to properties beyond a typical neighborhood distance. We found that many of the studies estimate values that might be considered to be "on site" or "neighborhood" values, as well as values considered to be "off site" values. Because, for the most part, there is no clear distinction between these groups, we propose a combined model that addresses values at varying distances from an amenity (see further discussion of the proposed model below).

Of the 8 stated preference studies reviewed, 4 value open space, 4 value trees or other vegetation, 3 value parks, 1 values greenways, 3 value water bodies, and 1 values wetlands. One stated preference study addresses conservation subdivisions, and two address street layout within a subdivision. Three studies evaluate amenities within a neighborhood or subdivision.

Table 1: Reviewed Studies that Value Potential LID Impacts

Category	Hedonic: Number of Studies	Stated Preference: Number of Studies
All studies	63	8
Amenities Valued		
General open space	29	4
Trees and other vegetation	25	4
Parks, gardens	21	3
Greenways	6	1
Riparian buffers	7	0
Habitat	5	0
Water bodies	19	3
Views	9	0
Wetlands	4	1
Locations or Development Type		
Parcel	20	0
Cluster housing	5	0
Conservation subdivisions	6	1
Street layout	0	2
Neighborhood	37	3
Off site	41	0

4 Approach for Modeling the Effects of LID on Property Values

[redacted]

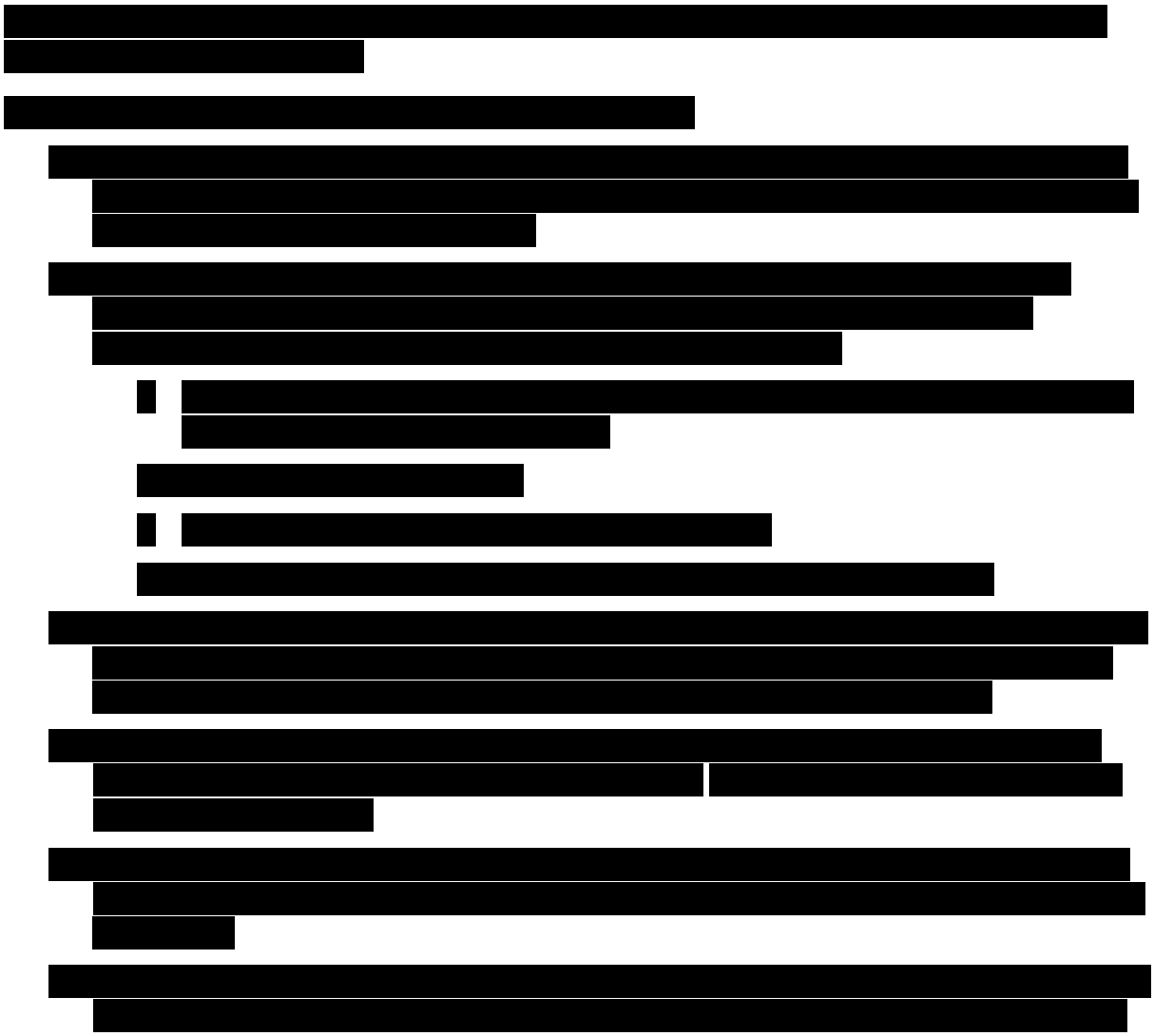
4.1 Summary of Key Existing Meta-analysis

Kroeger (2008) conducted a meta-analysis of hedonic values for open space, to produce an Excel-based "Open Space Property Value Estimator Tool" for Defenders of Wildlife (see also Kroeger, Loomis, and Casey 2008). Because the valuation tool focuses on wildlife benefits, it does not include values for agricultural lands or heavily used urban parks.

Kroeger initially estimated three separate models, based on the different measures used in the available studies. All three models predict the percent increase in property value. In the first model, value is expressed in terms of a decrease in distance to the nearest open space parcel. In the second model, value is a function of an increase in percent of open space within a certain radius. In the third model, value is a function of proximity to open space. This model includes adjacent open space (where distance is set to zero).

Because of the large number of variables in each model (12-16 variables), and small number of observations (29 in model 1, 22 in models 2 and 3), the model results were poor. Therefore, Kroeger devised a way to convert all of the measures to increases in percent of open space within a given radius, and estimated a single model. One specification of this model included a variable for population density, and another included dummy variables for urban and rural areas. However, these variables were not statistically significant. The final reduced model was based on 55 observations, and included the following variables: % change in open space and its square; dummy variables for forest, park, or farm land (wetlands used as base); a dummy variable for parcels protected from development; and a dummy for privately owned parcels.

4.2 Proposed [redacted]



[redacted]

5 Summary

In summary, few studies specifically address property values related to LID practices, and those that do often use open space as a proxy for LID effects. [redacted]

[redacted]

[redacted]

References

Bowman, T., J. Thompson, and J. Colletti. 2009. Valuation of open space and conservation features in residential subdivisions. *Journal of Environmental Management* 90: 321-330. doi:Article.

Fausold, Charles J., and Robert J. Lilieholm. 1996. *The Economic Value of Open Space: A Review and Synthesis*. Lincoln Institute of Land Policy Research Paper.

Kopits, E., V. McConnell, and M. Walls. 2007. The trade-off between private lots and public open space in subdivisions at the urban-rural fringe. *American Journal of Agricultural Economics* 89: 1191-1197. doi:Proceedings Paper.

Kroeger, Timm. 2008. Open Space Property Value Premium Analysis. June.

Kroeger, Timm, John Loomis, and Frank Casey. 2008. Final Project Completion Report: WHPRP 2006 Project Topic 1H: "Development of an Operational benefits Estimation Tool for the U.S.". June 30.

Lee, J. S., and M. H. Li. 2009. The impact of detention basin design on residential property value: Case studies using GIS in the hedonic price modeling. *Landscape and Urban Planning* 89: 7-16. doi:Article.

Mohamed, R. 2006. The economics of conservation subdivisions - Price premiums, improvement costs, and absorption. *Urban Affairs Review* 41: 376-399. doi:Article.

Netusil, Noelwah R. 2005. The Effect of Environmental Zoning and Amenities on Property Values: Portland, Oregon. *Land Economics* 81, no. 2: 227-246.

Shultz, Steven D, and David A King. 2001. The use of census data for hedonic price estimates of open-space amenities and land use. *Journal of Real Estate Finance and Economics* 22, no. 2 (May): 239.

Williams, E. S., and W. R. Wise. 2009. Economic Impacts of Alternative Approaches to Storm-Water Management and Land Development. *Journal of Water Resources Planning and Management-Asce* 135: 537-546. doi:Article.

Appendix 1: Bibliography of Hedonic Studies

Acharya, Gayatri, and Lynne Lewis Bennett. 2001. Valuing open space and land-use patterns in urban watersheds. *Journal of Real Estate Finance and Economics* (May).

Anderson, L.M., and H.K. Cordell. 1988. Influence of Trees on Residential Property Values in Athens, Georgia (U.S.A.): A Survey based on Actual Sales Prices. *Landscape and Urban Planning* 15: 153-164.

Anderson, S. T., and S. E. West. 2006. Open space, residential property values, and spatial context. *Regional Science and Urban Economics* 36: 773-789. doi:Article.

Anon. n.d. Thompson 2008 dfcost ben analysis of conservation developments MSThesisDukeU.pdf.

Anon. n.d. williams 2003 hydrologic and econ impacts of alternative resid land devel methods DissertationUFL.pdf.

Anon. n.d. Doss and Taff 1996.pdf.

Anon. n.d. Poudyal et al. 2009_urban recreation parks.pdf.

Anon. n.d. Ready and Abdalla Hedonic BerksLandUseLong 2003.pdf.

Anon. n.d. Donovan Butry 2008 market-based approaches to tree valuation ArbNews.pdf.

Anon. n.d. Earnhart 2001 combined revealed and stated prefs to value resid envir amenities LandEcon.pdf.

Anon. n.d. Geoghegan et al. 1997.pdf.

Anon. n.d. Pincetl et al 2003_toward a sustainable los angeles.pdf.

Anon. n.d. Shultz & Schmitz Water resources and housing devel Douglas Cnty UNO_Water_Report2008.pdf.

Anon. n.d. Smith et al. 2002.pdf.

Anon. n.d. Thorsnes 2002_the value of a suburban forest.pdf.

Anon. n.d. White and Leefers 2007_influence of natural amenities.pdf.

Anon. n.d. Theriault et al. 2002.pdf.

Asabere, P. K., and F. E. Huffman. 2009. The Relative Impacts of Trails and Greenbelts on Home Price. *Journal of Real Estate Finance and Economics* 38: 408-419. doi:Article.

Bark, R. H., D. E. Osgood, B. G. Colby, G. Katz, and J. Stromberg. 2009. Habitat preservation and restoration: Do homebuyers have preferences for quality habitat? *Ecological Economics* 68: 1465-1475. doi:Article.

Been, V., and I. Voicu. 2008. The effect of community gardens on neighboring property values. *Real Estate Economics* 36: 241-283. doi:Article.

Bin, Okmyung, Craig E. Landry, and Gregory F. Meyer. 2008. Riparian Buffers and Hedonic Prices: A Quasi-Experimental Analysis of Residential Property Values in the Neuse River Basin. East Carolina University Working Paper, November 3.

Bolitzer, B., and N. R. Netusil. 2000. The impact of open spaces on property values in Portland, Oregon. *Journal of Environmental Management* 59: 185-193. doi:Article.

Bowman, T., J. Thompson, and J. Colletti. 2009. Valuation of open space and conservation features in residential subdivisions. *Journal of Environmental Management* 90: 321-330. doi:Article.

Cape Ann Economics. Open Space Proximity and Land Values. N/A.

Cho, S. H., C. D. Clark, W. M. Park, and S. G. Kim. 2009. Spatial and Temporal Variation in the Housing Market Values of Lot Size and Open Space. *Land Economics* 85: 51-73. doi:Article.

Cho, S. H., N. C. Poudyal, and R. K. Roberts. 2008. Spatial analysis of the amenity value of green open space. *Ecological Economics* 66: 403-416. doi:Article.

Cho, Seong-Hoon, J.M. Bowker, and William M. Park. 2006. Measuring the Contribution of Water and Green Space Amenities to Housing
Values: An Application and Comparison of Spatially-weighted Hedonic
Models presented at the American Agricultural Economics Association Annual Meeting, July.

Colby, Dr. Bonnie, and Steven Wishart. 2002. Riparian Areas Generate Property Value Premium for Landowners. University of Arizona, Department of Agricultural and Resource Economics, January.

DesRosiers, Francois, Marius Theriault, Yan Kestens, and Paul Villeneuve. 2002. Landscaping and House Values: An Empirical Investigation. *JRER* 23.

Donovan, Geoffrey H., and David T. Butry. 2010. Trees in the city: Valuing street trees in Portland, Oregon. *Landscape and Urban Planning* 94, no. 2 (February 28): 77-83. doi:doi: DOI: 10.1016/j.landurbplan.2009.07.019.

Embrace Open Space. 2009. Hennepin County Economic Analysis - Executive Summary. June 1.

Espey, M., and K. Owusu-Edusei. 2001. Neighborhood Parks and Residential Property Values in Greenville, South Carolina. *Journal of Agricultural and Applied Economics* 33, no. 3: 487-492.

Geoghegan, J. 2002. The value of open spaces in residential land use. *Land Use Policy* 19: 91-98. doi:Article.

Hardie, I., E. Lichtenberg, and C. J. Nickerson. 2007. Regulation, open space, and the value of land undergoing residential subdivision. *Land Economics* 83: 458-474. doi:Article.

Heintzelman, M. A. 2010. Measuring the Property-Value Effects of Local Land Use and Preservation Referenda. *Land Economics* 86: 22-47. doi:Article.

Hitzhusen, Fred J., Nichole Yen, and Jack Schieffer. 2007. Willingness to Pay for LID Environmental Benefits. In , ed. Michael Clar, Bill Hunt, Daniel Medina, Shirley Clark, Elizabeth Fassman, Scott Struck, Eric Laramore, and Stephen Hokuff, 331:4. ASCE. http://dx.doi.org/10.1061/41007(331)4.

Hobden, David W., Gary E. Laughton, and Katherine E. Morgan. 2004. Green space borders--a tangible benefit? Evidence from four neighbourhoods in Surrey, British Columbia, 1980-2001. *Land Use Policy* 21, no. 2 (April): 129-138. doi:doi: DOI: 10.1016/j.landusepol.2003.10.002.

Irwin, E. G. 2002. The effects of open space on residential property values. *Land Economics* 78: 465-480. doi:Article.

Irwin, E. G., and N. E. Bockstael. 2001. The problem of identifying land use spillovers: Measuring the effects of open space on residential property values. *American Journal of Agricultural Economics* 83: 698-704. doi:Proceedings Paper.

Kopits, E., V. McConnell, and M. Walls. 2007. The trade-off between private lots and public open space in subdivisions at the urban-rural fringe. *American Journal of Agricultural Economics* 89: 1191-1197. doi:Proceedings Paper.

Lee, J. S., and M. H. Li. 2009. The impact of detention basin design on residential property value: Case studies using GIS in the hedonic price modeling. *Landscape and Urban Planning* 89: 7-16. doi:Article.

Luttik, Joke. 2000. The value of trees, water and open space as reflected by house prices in the Netherlands. *Landscape and Urban Planning* 48: 161-167.

Lutzenhiser, Margot, and Noelwah R. Netusil. 2001. The Effect of Open Spaces on a Home's Sale Price. *Contemporary Economic Policy* 19, no. 3: 291-298.

Mansfield, C., S. K. Pattanayak, W. McDow, R. McDonald, and P. Halpin. 2005. Shades of Green: Measuring the value of urban forests in the housing market. *Journal of Forest Economics* 11: 177-199. doi:Article.

Mohamed, R. 2006. The economics of conservation subdivisions - Price premiums, improvement costs, and absorption. *Urban Affairs Review* 41: 376-399. doi:Article.

Mooney, Sian, and Ludwig M Eisgruber. 2001. The influence of riparian protection measures on residential property values: The case of the oregon plan for salmon and watersheds. *Journal of Real Estate Finance and Economics* (May). http://proquest.umi.com/pqdweb?did=410776951&Fmt=7&clientId=16241&RQT=309&VName=PQD.

Moscovitch, Edward. 2007. The Economic Impact of Proximity to Open Space on Single-Family Home Values in Washington County, Minnesota. Embrace Open Space, May.

Munroe, D. K. 2007. Exploring the determinants of spatial pattern in residential land markets: amenities and disamenities in Charlotte, NC, USA. *Environment and Planning B-Planning & Design* 34: 336-354. doi:Article.

Netusil, Noelwah R. 2005. The Effect of Environmental Zoning and Amenities on Property Values: Portland, Oregon. *Land Economics* 81, no. 2: 227-246.

———. 2006. Economic Valuation of Riparian Corridors and Upland Wildlife Habitat in an Urban Watershed. *Journal of Contemporary Water Research & Education*, no. 134 (July): 39-45.

Netusil, Noelwah R, Sudip Chattopadhyay, and Kent F Kovacs. 2010. Estimating the Demand for Tree Canopy: A Second-Stage Hedonic Price Analysis in Portland, Oregon. *Land Economics* 86, no. 2: 281-293.

Nicholls, Sarah, and John L. Crompton. 2005. The Impact of Greenways on Property Values: Evidence from Austin, Texas. *Journal of Leisure Research* 37, no. 3: 321-341.

Paterson, Robert W, and Kevin J Boyle. 2002. Out of Sight, Out of Mind? Using GIS to Incorporate Visibility in Hedonic Property Value Models. *Land Economics* 78, no. 3: 417-425.

Payton, S., G. Lindsey, J. Wilson, J. R. Ottensmann, and J. Man. 2008. Valuing the benefits of the urban forest: a spatial hedonic approach. *Journal of Environmental Planning and Management* 51: 717-736. doi:Article.

Phaneuf, D. J., V. K. Smith, R. B. Palmquist, and J. C. Pope. 2008. Integrating property value and local recreation models to value ecosystem services in urban watersheds. *Land Economics* 84: 361-381. doi:Article.

Poudyal, N. C., D. G. Hodges, B. Tonn, and S. H. Cho. 2009. Valuing diversity and spatial pattern of open space plots in urban neighborhoods. *Forest Policy and Economics* 11: 194-201. doi:Article.

Qiu, Zeyuan, Tony Prato, and Gerry Boehrn. 2006. ECONOMIC VALUATION OF RIPARIAN BUFFER AND OPEN SPACE IN A SUBURBAN WATERSHED¹. *Journal of the American Water Resources Association* 42, no. 6: 1583-1596.

Sander, H. A., and S. Polasky. 2009. The value of views and open space: Estimates from a hedonic pricing model for Ramsey County, Minnesota, USA. *Land Use Policy* 26: 837-845. doi:Article.

Shultz, Steven D, and David A King. 2001. The use of census data for hedonic price estimates of open-space amenities and land use. *Journal of Real Estate Finance and Economics* 22, no. 2 (May): 239.

Towe, Charles. 2009. A Valuation of Subdivision Open Space by Type. *American Journal of Agricultural Economics* 91, no. 5: 1319-1325.

Troy, A., and J. M. Grove. 2008. Property values, parks, and crime: A hedonic analysis in Baltimore,

MD. *Landscape and Urban Planning* 87: 233-245. doi:Article.

Williams, E. S., and W. R. Wise. 2009. Economic Impacts of Alternative Approaches to Storm-Water Management and Land Development. *Journal of Water Resources Planning and Management-Asce* 135: 537-546. doi:Article.

Wu, JunJie, Richard M Adams, and Andrew J Plantinga. 2004. Amenities in an Urban Equilibrium Model: Residential Development in Portland, Oregon. *Land Economics* 80, no. 1: 19-32.

Appendix 2: Bibliography of Stated Preference Studies

Anon. n.d. Johnston et al. 2002.pdf.

Anon. n.d. Earnhart 2001 combined revealed and stated prefs to value resid envir amenities LandEcon.pdf.

Anon. n.d. Lindsey and Knaap 1999.pdf.

Anon. n.d. Roe et al. 2004.pdf.

Bowman, T., J. Thompson, and J. Colletti. 2009. Valuation of open space and conservation features in residential subdivisions. *Journal of Environmental Management* 90: 321-330. doi:Article.

Morrow-Jones, H. A., E. G. Irwin, and B. Roe. 2004. Consumer preference for neotraditional neighborhood characteristics. *Housing Policy Debate* 15: 171-202. doi:Article.

Netusil, Noelwah R, Sudip Chattopadhyay, and Kent F Kovacs. 2010. Estimating the Demand for Tree Canopy: A Second-Stage Hedonic Price Analysis in Portland, Oregon. *Land Economics* 86, no. 2: 281-293.

Qiu, Zeyuan, Tony Prato, and Gerry Boehrn. 2006. ECONOMIC VALUATION OF RIPARIAN BUFFER AND OPEN SPACE IN A SUBURBAN WATERSHED¹. *Journal of the American Water Resources Association* 42, no. 6: 1583-1596.